

PARASITISM, MORPHOLOGY OF CRITICAL ASPECTS OF
SEXUAL AND ASEXUAL REPRODUCTION, AND
TAXONOMY OF THE CHOANEPHORACEAE
(MUCORALES)

BY

ADRIAN W. POITRAS

B.S., University of Illinois, 1940

M.S., University of Illinois, 1947

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN
BOTANY IN THE GRADUATE COLLEGE OF
THE UNIVERSITY OF ILLINOIS, 1950

URBANA, ILLINOIS

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PARASITISM, MORPHOLOGY OF CRITICAL ASPECTS OF
SEXUAL AND ASEQUAL REPRODUCTION, AND
TAXONOMY OF THE CHOANEPHORACEAE
(MUCORALES)

This investigation of the Choanephoraceae consists of (1) an evaluation of the literature on parasitism by fungi of this family (a) bringing together the diversely published reports concerning them into concise form and (b) to determine if any significant contributions influencing the taxonomy of the group exist; (2) experimental studies (a) on the morphology of "conidia" and sporangioles to determine their significance in establishing genera and (b) on the comparative morphology of sexual reproduction as observed between crosses of all isolates assembled for this study; and (3) a revision of the taxonomy of the family based on observations of the morphology of sexual and asexual reproduction and a consideration of the importance of hosts.

Twenty isolates of *Choanephora cucurbitarum* (Berkeley and Ravenel) Thaxter were assembled for this study. Fourteen of these were isolated from soil samples, ten of which were taken locally in Illinois, indicating that this species is more prevalent in soil, at least locally, than is generally believed. Five isolates representing *C. trispora* (Thaxter) Sinha (= *Blakeslea trispora* Thaxter) were acquired and slides of *C. conjuncta* Couch were studied. Several isolates of *Cunninghamella* and the type culture of *Cokeromyces recurvatus* Poitras were also available for this investigation.

From a survey of forty-five publications dealing with the pathogenic relationships of the four currently recognized species of the Choanephoraceae it has been shown that fungi of this family are capable of attacking twenty-two genera of economically important plants in the warmer zones of four continents (North America, South America, Africa and Asia). Most reports indicated that infections are initiated through the flowers of the plants attacked, although direct infection of the leaves was reported in many instances. Invasion of other plant parts, such as stems and fruits, from the loci of infection was reported in some instances. While a parasitic existence is generally regarded as normal for species of the Choanephoraceae, all species are known to be capable of completing their life cycles in culture on synthetic media and may also occur in nature as saprophytes. Since none of the species of the Choanephoraceae appear to be limited to a single host, it

was concluded that the phytopathological relationships of these offer no suitable basis for proposals influencing the taxonomy of the family.

The "conidia" of *Choanephora* were demonstrated to be monosporous sporangioles and, except for the number of spores in each sporangiole, are fundamentally similar to sporangioles produced by *Blakeslea*. It was concluded that the number of spores developed in each sporangiole is a quality of degree rather than of generic significance and that this characteristic is, therefore, of specific importance only.

The occurrence of striations on the walls of spores produced by species of the Choanephoraceae was investigated. Striations have been observed on the walls of all spore types of species in this family which were available for study, and it appears that this is of fundamental importance as a family characteristic.

The development of sporangioles over the surface of terminal capitate vesicles of sporangiophores is not a characteristic limited to the Choanephoraceae in the Mucorales, but is a characteristic of certain genera in other families as well. This characteristic, therefore, appears to have been overemphasized as a major diagnostic character of the Choanephoraceae.

The production of zygospores between the curved tips of hyphal branches which arise from complex entanglements of the vegetative mycelium is the typical method of zygospore development in the Choanephoraceae. This characteristic method of zygospore formation, the possession of striate spores, and the production of sporangia and of sporangioles on separate sporangiophores, when considered together, appear to be of primary importance for distinguishing species of the Choanephoraceae from other members of the Mucorales.

Careful examination of crosses between sexually compatible isolates of *Choanephora cucurbitarum* has indicated that varying degrees of sexual vigor exist in the different isolates assembled for this study. When crossed with sexually compatible isolates of *C. cucurbitarum*, isolates of *C. trispora* hybridized imperfectly, possibly indicating a close relationship between these species.

The taxonomy of the Choanephoraceae, based on these observations on the morphology of sexual and asexual structures, and on parasitism, has been reviewed. *Choanephora* is the only genus that has been retained as valid. *Blakeslea* is considered synonymous with *Choanephora*. The genera *Cunninghamella*, *Sigmoideomyces*,

and *Thamnocephalis* are regarded as more logically placed in a separate family, the Cunninghamellaceae, and appear not too closely related to the Choanephoraceae as recognized here. *Cunninghamella*, the type genus of this family, produces zygospores in a different manner than is characteristic of the Choanephoraceae, and the spores of this and of the other two genera included in the Cunninghamellaceae possess spiny or reticulate spore walls instead of striate walls as do species of the Choanephoraceae. The separation of an inner spore wall from an outer sporangial membrane never has been demonstrated conclusively in the "conidia" of these genera. The genus *Cokeromyces* was rejected from the Choanephoraceae, since its only characteristic in common with species of this family, is its production of sporangioles over the surface of terminal capitate vesicles of the sporangiophore. *Cokeromyces* has been assigned tentatively to the family Thamniaceae.

Four species of *Choanephora*, *C. infundibulifera*, *C. simsonii*, *C. cucurbitarum*, and *C. trispora* (= *Blakeslea trispora*), were retained as valid. The possibility that isolates now known and referred to as *C. simsonii* and *C. cucurbitarum* are synonymous with *C. infundibulifera* was pointed out, but since material of *C. infundibulifera* and *C. simsonii* was not available for study and comparison with *C. cucurbitarum*, it was concluded that, for the present, these species might be retained. Slides of the "conidia," sporangia, and zygospores of *C. conjuncta* were studied and a comparison of this species with *C. cucurbitarum* was made. It was concluded that the differences existing between these two were insufficient to warrant retention of two specific entities and that *C. conjuncta*, therefore, is a synonym of *C. cucurbitarum*. A summary of the synonymy of species retained in *Choanephora* has been provided.

VITA

Adrian William Poitras was born at Rockford, Illinois, on June 12, 1918. He attended the Rockford public schools and the Rockford Senior High School, graduating in June, 1936. During the years 1936-1938 he attended Blackburn College, Carlinville, Illinois, and in 1938 transferred to the University of Illinois, receiving the B.S. degree in June, 1940. During the years 1940-1941 he pursued graduate study in Zoology, with a minor in Botany, at the University of Illinois. In 1942 he taught Biology in the Community High School, Greenfield, Illinois, for one semester. During the years 1942-44 he served as a civilian instructor for the Army Air Forces at Chanute Air Base, Illinois, and the Army Air Forces Technical Training School at Yale University, New Haven, Connecticut. In July 1944 he entered military service with the Army of the United States. He graduated from Officer Candidate School as a second lieutenant in the Infantry in June, 1945, and served in the European Theater of Operations as an Ordnance Officer with the Third Infantry Division until September, 1946. In 1947 he was appointed Assistant in Botany and returned to the University of Illinois to continue graduate study, where he received the Master of Science in the Teaching of Biological Science in October, 1947. He was awarded a graduate fellowship in Botany in February, 1949, and this fellowship was renewed for the academic year 1949-1950. The author is a member of the Botanical Society of America, the Mycological Society of America, the Illinois State Academy of Science, and Sigma Xi. He is author of: "A new aquatic species of *Pythium*," *Mycologia* 41: 171-176. 1949; (with N. E. Stevens) "Bacterial Wilt on sweet corn, 1945-1948," *Plant Disease Reporter* 33 (3): 161-165. 1949; (with L. Shanor and R. K. Benjamin) "A new genus of the Choanephoraceae," *Mycologia* 42: 271-278. 1950; and (with R. K. Benjamin) "An addition to the myxomycete genus *Comatricha*," *Mycologia*, in press.

